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ABSTRACT

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CAI CENTER

TECH MEMO

EFFECTS OF ANXIETY, RESPONSE MODE, SUBJECT MATTER FAMILIARITY AND LEARNING TIME ON ACHIEVEMENT IN COMPUTER-ASSISTED LEARNING

Barbara L. Leherissey, Harold F. O'Neil, Jr.,
Darlene L. Heinrich, and Duncan N. Hansen

Tech Memo No. 42
September 1, 1971
Tallahassee, Florida

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Duncan N. Hansen
Director
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ABSTRACT

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EFFECTS OF ANXIETY, RESPONSE MODE, SUBJECT MATTER FAMILIARITY, AND LEARNING TIME ON ACHIEVEMENT IN COMPUTER-ASSISTED LEARNING

Barbara L. Leherissey, Harold F. O'Neil, Jr., Darlene L. Heinrich, and Duncan N. Hansen

The present study sought to (a) replicate the findings of previous research on the process of anxiety within a computer-assisted instruction (CAI) situation which involved covert and overt responding to problem-solving materials (Leherissey, O'Neil, and Hansen, 1971); and (b) extend these findings by creating a shortened instructional treatment designed to reduce time spent on the CAI task, in order to reduce state anxiety and improve performance.

A theory which provides the conceptual framework within which research on anxiety and CAI learning can be examined is Spielberger's (1966) Trait-State Anxiety Theory. According to Spielberger (1966), state anxiety (A-State) refers to a transitory state or condition of the organism that is characterized by feelings of tension or apprehension and heightened autonomic nervous system activity. On the other hand, trait anxiety (A-Trait) implies individual differences in anxiety proneness, i.e., the disposition to respond with elevations in A-State under conditions that are characterized by some threat to self-esteem.

Since state anxiety level would be expected to vary as a function of the individual's perception of a situation at a given point in time, periodic measures of A-State can provide an accurate assessment of the impact of instructional treatments on the learner. The State-Trait Anxiety Inventory (STAI) developed by Speilberger, Gorsuch, and Lushene (1970) has proven to be a viable research instrument for clarifying the complex relationships between anxiety and performance in a CAI learning task (Leherissey, O'Neil, & Hansen, In Press; Leherissey et al., 1971; O'Neil, Spielberger, & Hansen, 1969; O'Neil, Hansen, & Spielberger, 1969).

Previous research with familiar and technical programmed instruction (PI) materials developed by Tobias (1968), and adapted for CAI presentation, revealed discrepant findings between PI and CAI presentation modes (Leherissey et al., 1971). That is, whereas Tobias (1968) found no differences between the reading and constructed response groups on the portion of the posttest covering familiar learning materials, Leherissey et al. (1971) found the reading group to perform significantly better than the constructed response group in the familiar portion of the posttest. Moreover, whereas Tobias found that a constructed response mode led to performance compared to a reading mode on technical PI materials dealing with heart disease, Leherissey et al, (1971) found no differences between reading and constructed response groups presented similar materials via CAI.

In interpreting the above findings, Leherissey et al. (1971) suggested that the additional finding of significantly higher A-State scores for students in the constructed response group relative to the reading group during the technical portion of the learning program and posttest, and the finding that students in the constructed response group took nearly twice as long as students in the reading group to complete the instructional program, may have served to depress the constructed response group's posttest performance. The associated greater memory load for students in the constructed response group relative to students in the reading group may also have contributed to the failure to find either comparable or superior performance for the constructed response group on the familiar learning materials. Further, written and verbal comments by students in the constructed response group suggested that students in this group were made more hostile than students in the reading group by the length of time required to complete these instructional materials.

The present study, therefore, sought to replicate the findings of Leherissey et al. (1971) and also to reduce A-State and improve performance by shortening the amount of time spent on the instructional materials. Students were

presented two forms of the verbal and graphical materials of Leherissey et al (1971) (reading, constructed response). In addition a long and short version of each was used. Thus, there were two versions and two lengths, a long one (same as Leherissey et al.) and a shortened one. In addition, hostility was measured to explicate and extend the previous findings.

The major predictions were as follows: (a) students in the long constructed response version would have higher A-State than students in the long reading version, whereas there would be no difference in the A-State scores of students in the short reading and constructed response versions; (b) the short constructed response group would make more correct responses on the technical posttest covering the short materials than the short reading group, whereas there would be no difference in the correct responses of the long reading and constructed response groups; and (c) students in the long constructed response version would have higher hostility scores than students in the long reading version, whereas there would be no difference in hostility scores for students in the short reading and constructed response versions.

Method

<u>Subjects</u>

One hundred and twenty-eight female undergraduate students enrolled in general psychology classes at Florida State University participated in the study. The subjects were grouped on level of A-Trait, high (HA), medium (MA), and low (LA), and were randomly assigned to one of four experimental conditions, reading-long (R-L), reading-short (R-S), constructed response-long (CR-L), and constructed response-short (CR-S). The subjects were run in small groups of 8 to 15 subjects; a total of 12 experimental sessions were required to run all groups of subjects. Each subject participated in one session lasting from approximately one to three hours. The distribution of A-Trait means and standard deviations across experimental conditions is presented in Table 1. It may be noted that LA, MA, and HA subjects across response modes and length conditions are well matched

on A-Trait scores.

Table 1
Mean A-Trait Scores for LA, MA, and HA Subjects
in Response Mode and Length Conditions

Groups	Low (LA)	A-Trait Level Medium (MA)	High (HA)
All groups (N=128)			
Mean	29.14	37.85	48.30
SD	3.33	2.55	5.35
Reading-Short (N=32)			
Mean	28.67	38.54	48.90
SD	3 67	2.40	4.20
Reading-Long (N=32)			
Mean	28.67	38.23	47.60
SD	3.94	2.42	5.87
Constructed Response-Short			
(N=32) Mean	29.44	37.69	48.40
SD	2.13	2.50	3.86
Constructed Response-Long			
(N=32) Mean	29 78	36.92	48.30
SD	3.73	2.87	7.47

Apparatus

An IBM 1500 system (IBM, 1967) was used to present the learning materials. Terminals for this system consist of a cathode ray tube (CRT), a light pen, and a typewriter keyboard. The terminals were located in a sound-deadened, air conditioned room The STAI A-State scales were presented on the CAI system in order to measure A-State while subjects worked through the learning materials. The CAI system recorded all subject's responses, including response latencies.

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Affective Measures

The State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (1970) was used to measure both A-Trait and A-State in the same manner as described by Leherissey et al. (1971). The short form (5-item) A-State scales were given after the pretest via paper and pencil; immediately before the learning materials; immediately after the familiar, initial technical, and remaining technical materials via CAI; and after the posttest via paper and pencil.

The Multiple Affect Adjective Check List (MAACL) developed by Zuckerman and Lubin (1965) was used to assess hostility toward the learning task. This measure is comprised of 132 adjectives keyed for three affects of anxiety, depression, and hostility. Individuals respond to the list by checking words which describe the way they felt while learning the instructional materials. For this study only the hostility scale (30 items) was scored.

Procedure

The experimental session was divided into three periods: (a) a pretask period during which subjects were administered the A-Trait scale with standard instructions. This scale was collected and while being scored, subjects were given the pretest package containing the 17-item familiar pretest, and a short A-State scale to be completed following the pretest. The subjects were then assigned to one of the four treatment conditions based on their A-Trait scores: (a) R-S, (b) R-L, (c) CR-S, or (d) CR-L. The subjects then received written instructions on the operation of the CAI terminals.

Performance Period

All subjects were then seated at the CAI terminals and were informed that they would be receiving different versions of a program on heart disease and that subjects would, therefore, be finishing at different times. Subjects were further instructed to come to the proctor's desk upon completion of the program to receive further directions.

After "signing on" the short form of the A-State scale was presented on the CRT with standard instructions. Next, depending upon the response mode condition to which subjects had been assigned, further instructions were given as to how to proceed through the learning materials. Specific instructions given to each of the treatment groups are as follows:

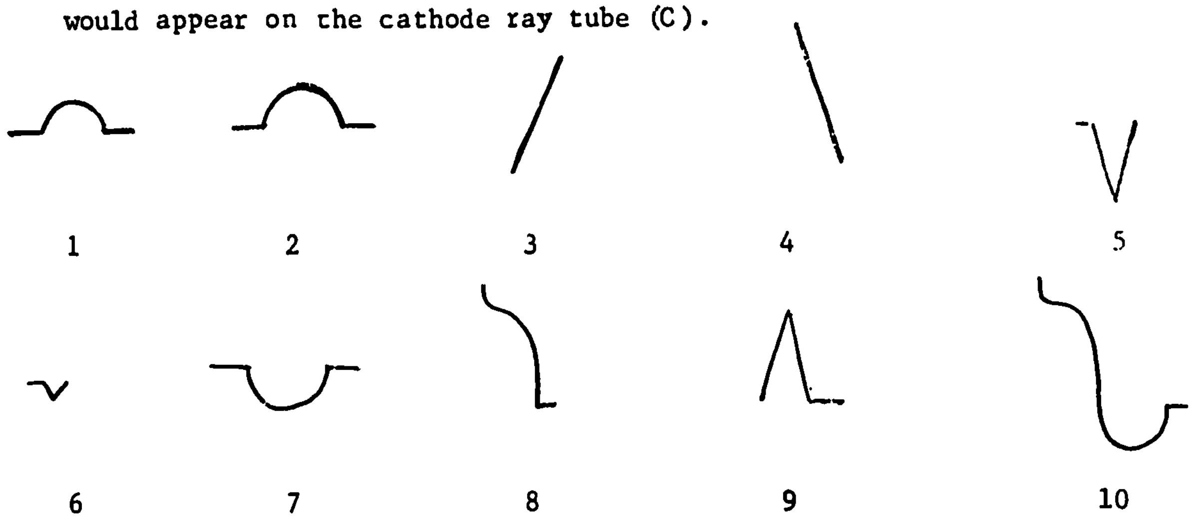
1. Reading: "You will not be required to supply an answer to any of the frames. Simply press the space bar to continue on to the next frame. When you have finished the instructional material, you will be given a test on the material."

2. Constructed Response: "The material is presented on a series of frames, each of which requires you give one or more answers. To answer each frame, you must type in the word or number that completes each blank and enter that response. On each frame of the material, when you have filled in all the blanks, the correct answer will appear on the screen before the next frame is presented. You will only be required to respond once to each frame, regardless of whether your answer is right or wrong. When you have finished the instructional materials, you will receive a test on the material." The constructed response group was then given practice in the operation of the keyboard and was instructed on the enter and erase functions.

All subjects were instructed to proceed through the learning materials at their own rate. Students in the constructed response-short and reading-short groups terminated shortly after beginning the technical diagrammatic frames containing EKG tracings, whereas students in the long versions completed the technical materials. The constructed response groups were given a handout of 10 possible EKG tracing segments for the technical pictorial materials and instructed to type in the combination of numbers from 0-9 which would complete a sample frame for this procedure. Figure 1 illustrates how subjects in the constructed response group drew EKG tracings via CAI. For example, if the subject was asked

to draw the Normal EKG tracing, he referred to a handout of tracing segments (A), and chose the correct sequence of numbers which would construct this tracing (B). He then typed in these numbers one at a time and the normal EKG tracing would appear on the cathode ray tube (C).

A



B Correct sequence of numbers to "draw" Normal EKG tracing: 1, 6, 3, 4, 2

C

Normal EKG tracing

Figure 1. Illustration of how students in CR version "drew" EKG tracings via CAI.

During this performance period, all subjects were presented the short form of the A-State scale with retrospective state instructions immediately after the familiar materials and following the initial technical materials. In addition, subjects on long versions responded to an A-State scale following the remaining technical section.

Posttask Period

After each subject had completed the instructional program and last A-State scale, she "signed off" the CAI terminal and reported to the proctor where she received the MAACL and the posttest package containing the posttest (short and long form as appropriate), and a 5-item A-State scale to be completed following the posttest.

After the completion of the posttest package, subjects were informed that the task was quite difficult and were reassured that their performance had been satisfactory. The subjects were also given some additional information concerning the general nature of the experiment and requested not to discuss the experiment with their classmates.

Results

For the purpose of clarifying the presentation of the findings in this study, the results will be reported in the following order: (a) Anxiety Data during the Experimental Session; (b) Performance Data on Pre-and Post-Achievement Measures; (c) Learning Time Data during the Instructional Materials; and (d) Hostility Data on the Instructional Materials.

Anxiety Data

Effects of Response Modes and Program Length on A-State for LA, MA, and HA Students

In order to investigate the relationships between level of A-Trait, response modes, and program length on A-State scores obtained during the experiment, the analyses were divided into three major periods. The first analysis focused on A-State measured during the performance period; and the third analysis focused on A-State measured after the posttest. The cut-off scores for the LA and HA groups corresponded to the upper and lower quantities of the published A-Trait norms for college undergraduate females (Spielberger, at al, 1970).

The means and standard deviations for the A-State scores measured during the experiment for LA, MA and HA students in the response modes and length conditions are presented in Table 2. Since students in the short versions did not receive the Remaining Technical Materials (T_R), they did not receive the TR A-State scale. Four sets of three-factor analyses of variance were calculated on this data. The independent variables in the analyses were level of A-Trait (LA,MA,HA), response modes (R, CR), and program length (short, long).

Pretest A-State Analysis

The dependent variable in the first analysis was the mean A-State scores measured following the pretest. Results of this analysis indicated that no main effects or interactions were significant. Thus, neither level of A-Trait, response modes, nor length affected pretest A-State levels.

Table 2
Mean A-State Scores for LA, MA, and HA Students in Response Mode and Length Conditions During the Experiment

Groups	Pretest Period After	Pre	Performance Familiar	Period $Tech_I$	$Tech_R$	Posttest Period After
All groups (N=128)						
Mean	9.93	10.72	9.42	9.99	10.44	10.74
SD	3.67	3.48	3.60	4.28	4.54	4.23
LA (N=9)						
Mean	9.11	8.22	7.22	6.56	7.89	8.33
SD	4.19	2.82	2.22	2.65	4.31	4.06
MA (N=13)						
Mean	10.92	11.62	9.46	8.77	9.77	10.23
SD	2.98	3.28	2.30	2.24	2.86	2.74
HA (N=10)						
Mean	9.80	11.40	9.60	10.20	9.80	9.80
SD	3.26	3.57	3.63	5.12	3.99	3.26
LA (N=9)						
Mean	8.11	8.89	8.56	7.00		7.44
SD	3.76	3.14	3.43	2.83		3.25
MA (N=13)						
Mean	10.31	12.69	10.85	10.31		12.23
SD	4.52	3.59	4.72	3.96		4.53
HA (N=10)						
Mean	10.00	11.70	9.60	10.40		9.50
SD	3.62	3.40	3.34	3.95		3.34

Table 2 continued

Groups	Pretest Period After	Performance Period Pre	Familiar	$Tech_I$	$Tech_R$	Posttest Period After
LA (N=9)						
Mean	8.56	9.89	7.78	9.44	10.78	9.44
SD	3.32	2.47	3.03	4.22	4.68	3.84
MA (N=13)						
Mean	9.92	9.46	8.92	9.62	10.15	11.77
SD	3.35	3.62	3.71	4.59	4.68	4.97
HA (N=10)						
Mean	13.90	12.60	10.80	9.90	13.80	13.80
SD	4.07	1.78	3.39	4.73	4.34	4.78
LA (N=9)						
Mean	9.78	9.89	8.22	10.67		9.67
SD	3.07	4.34	2.28	4.00		3.77
MA (N=13)						
Mean	8.77	10.00	10.38	11.77		12.31
SD	2.95	3.63	4.96	5.05		5.15
HA (N=10)						
Mean	9.50	11.50	10.50	14.50		12.50
SD	3.17	3.41	3.72	3.21		2.64

Performance Period

In order to evaluate changes in A-State during the CAI learning task, two analyses of variance evaluated changes in A-State during the performance period The first analysis of variance with repeated measures focused on A-State measured before the task. The remaining technical measure was used as the final measure for the students in the long versions whereas the initial technical A-State scale was used as the final measure for students in the short versions.

Results of the first analysis of variance indicated a significant response modes by periods interaction ($F=8/02$, $df=2/232$ $p < .001$). As is shown in Figure 2, the reading groups' A-State scores decreased from the Pre-measure through the familiar materials and remained relatively constant during the initial technical materials, increased during the initial technical materials. In addition, HA students had higher A-State scores ($\bar{x}=11.06$) than either MA ($\bar{x}=10.32$) or LA students ($\bar{x}=8.53$). This main effect of A-Trait was significant at the $p<.001$ level ($F=7.05$, $df=2/116$). Moreover, A-State which was highest initially ($\bar{x}=10.73$), decreased during the familiar materials ($\bar{x}=9.42$), and remained relatively the same during the initial technical materials ($\bar{x}=9.99$). This main effect of periods was significant at the $p<.001$ level ($F=8.53$, $df=2/232$).

There was no main effect nor interaction due to program length. Since the length variable was not operationalized at this point, this ANOVA indicates that the length groups were well matched on A-State.

To directly test the impact of length, the second ANOVA in the performance period focused on A-State at the completion of the task. The results of this ANOVA indicated that HA students had higher

A-State scores ($\bar{x}=12.13$) than either MA ($\bar{x}=10.50$) or LA students ($\bar{x}=9.09$). This main effect of A-Trait was significant at the $p<.01$ level ($F=4.84$, $df=2/116$). In addition, students in the constructed response group had higher A-State scores ($\bar{x}=11.89$) than students in the reading group ($\bar{x}=9.33$). This main effect of response modes was significant at the $p<.001$ level ($F=12.97$, $df=1/116$). No other main effects or interactions were significant.

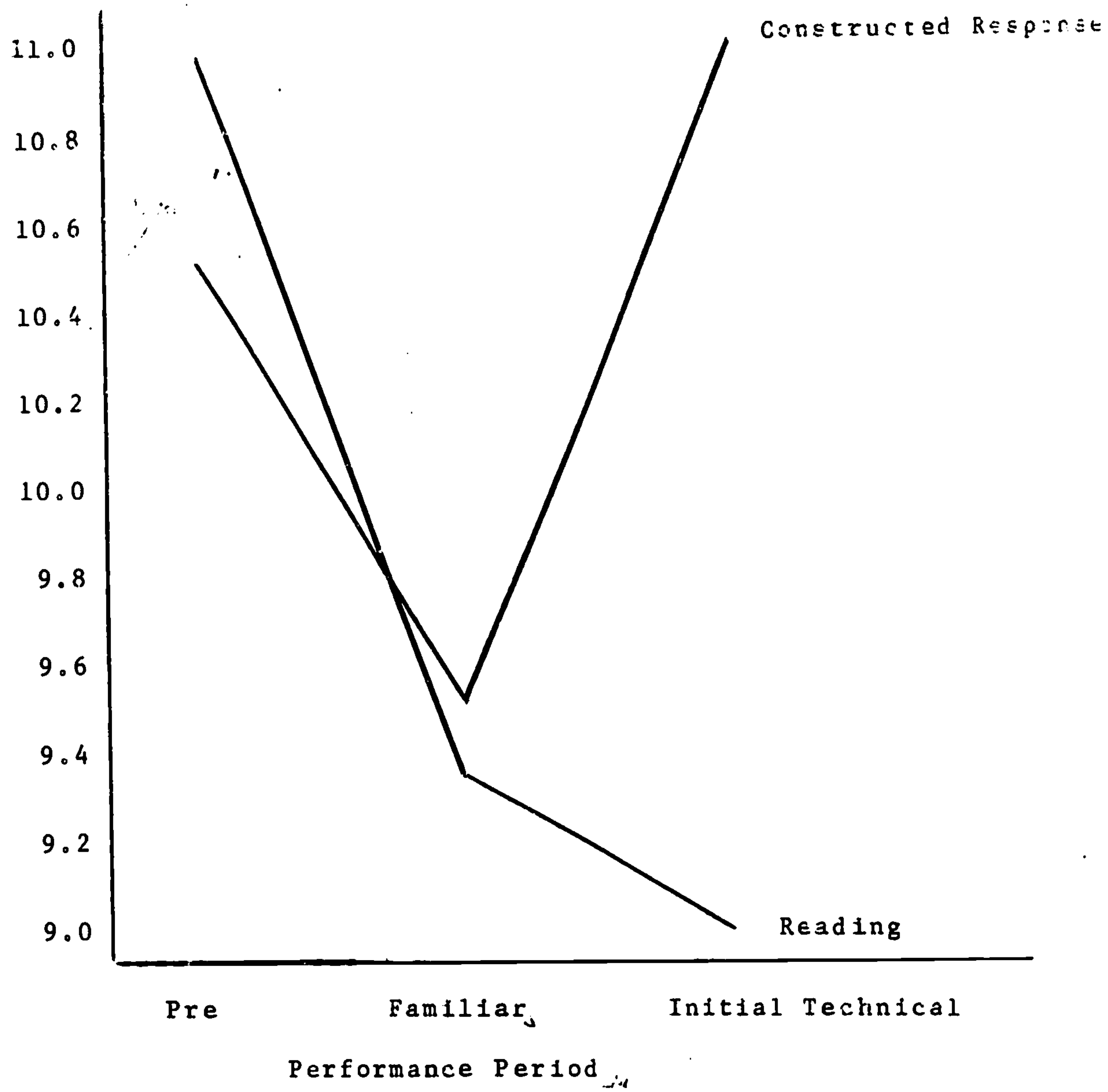


Figure 2. Mean A-State scores for students in the reading and constructed response versions in the performance period.

Posttest A-State Analysis

The dependent variable in the fourth analysis of variance was mean A-State scores measured after the posttest. Results of the analysis revealed that HA students had higher A-State scores ($\bar{x}$=11.40) than either MA ($\bar{x}$=11.64) or LA ($\bar{x}$=8.72) students (F=6.39, df=2/166, p<.005). In addition, subjects in the constructed response groups had higher levels of A-State ($\bar{x}$=11.69) than subjects in the reading group ($\bar{x}$=9.80) groups. This main effect of response modes was significant at the p<.01 level (F=7.70, df=1/116). No other main effects or interactions were significant.

Performance Data on Achievement Measures

Effects of Response Modes and Program Length on Pretest Performance for LA, MA, and HA Students

The means and standard deviations of correct responses for LA, MA, and HA students in the response modes and length conditions on the pretest are shown in Table 3.

To determine whether trait anxiety, response modes, and length were related to student performance on the pretest, a three-factor analysis of variance was calcuated. Independent variables in this analysis were level of A-Trait, (LA,MA,HA), response modes (R, CR), and program length (short, long). The dependent variable in this analysis was the number of correct responses on the pretest. In spite of randomization, results indicated that the reading group had fewer correct responses ($\bar{x}$=7.39) than the constructed response group ($\bar{x}$=8.28). This main effect approach significance (F=3.21, df= 1/116, p<.10). Moreover, students assigned to the long versions had significantly higher pretest scores ($\bar{x}$=8.56) than subjects assigned to the short versions ($\bar{x}$=7.84). This main effect of length was

significantly at the $p < .01$ level ($F=7.69$, $df=1/116$).

Table 3
Mean Correct Responses on the Pretest for LA, MA, and HA Students in the Response Mode and Length Conditions

Groups	A-Trait Level Low (LA)	Medium (MA)	High (HA)
All groups (N=128)			
Mean	7.89	7.83	7.80
SD	3.13	3.09	2.41
Reading-Long Mean (N=32)			
Mean	7.56	9.00	8.20
SD	2.30	2.35	2.53
Reading-Short Mean (N=32)			
Mean	6.67	5.46	7.50
SD	3.16	3.71	2.22
Constructed Response-Long			
(N=32) Mean	10.00	9.07	7.30
SD	4.06	2.36	2.58
Constructed Response-Short			
(N=32) Mean	7.33	7.77	8.20
SD	2.00	2.52	2.53

Effects of Response Modes and Program Length on Pretest Performance for Low, Medium, and High A-State Students

Also of interest in the present study was whether state anxiety, response modes, and program length were related to student performance on the pretest. The means and standard deviations of correct responses on the pretest for low, medium, and high A-State students in the response modes and length conditions are shown in Table 4.

The independent variables for this analysis were level of A-State during the pretest (low, medium, high), response modes (R,CR), and length (short, long). The students were divided into low, medium,

and high A-State groups by ranking the distribution of A-State scores on the retrospective A-State measure given after the pretest and dividing this distribution into thirds. The range of low A-State scores was 5-7; medium A-State scores ranged from 8-11; the range of high A-State scores was 12-20. The dependent variable in this analysis was mean number of correct responses on the pretest. As in the previous analysis, the results indicated, in spite of randomization, the students in the reading groups had fewer correct

Table 4
Mean Correct Responses on the Pretest for Low, Medium, and High A-State Students in the Response Mode and Length Conditions

Groups	A-STATE LEVEL Low	Medium	High
Reading-Long (N=32)			
Mean	6.71	9.00	8.50
SD	2.43	2.33	2.12
Reading-Short (N=32)			
Mean	5.64	7.30	6.13
SD	2.20	2.95	4.52
Constructed Response-Long			
(N=32) Mean	10.00	8.14	8.82
SD	5.20	1.51	2.96
Constructed Response-Short			
(N=32) Mean	7.75	7.45	8.22
SD	2.10	2.91	2.05

responses on the prestest ($\bar{X}$=7.39) than students in the constructed response group ($\bar{X}$=8.28). This main effect of response modes was significant at the $p<.01$ level (F=5.49, df=1/116). Further, students in the short version had fewer correct response ($\bar{X}$=7.11), than students in the long version ($\bar{X}$=8.84). This main effect of length was significant at the $p<.01$ level (F=8.19, df=1/116).

Table 5
Mean Correct Responses on the Familiar Posttest for Low, Medium, and High A-Trait Students in the Response Mode and Length Conditions

Groups	A-Trait Levels Low	Medium	High
Reading-Long (n=32)			
Mean	16.11	16.92	17.60
SD	2.57	2.33	3.06
Reading-Short (n=32)			
Mean	18.11	15.46	17.20
SD	3.10	3.93	2.20
Constructed Response-Long			
(n=32) Mean	15.56	12.62	12.20
SD	2.92	2.40	2.20
Constructed Response-Short			
(n=32) Mean	15.33	15.15	17.20
SD	3.77	2.67	3.39

Table 6
Mean Correct Responses on the Initial Technical Posttest for Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups	A-Trait Level Low	Medium	High
Reading-Long (n=32)			
Mean	14.78	18.23	18.00
SD	4.82	3.92	5.21
Reading-Short (n=32)			
Mean	18.44	13.08	18.20
SD	3.54	6.30	6.07
Constructed Response-Long			
(n=32) Mean	20.22	19.00	18.40
SD	2.59	3.19	3.84
Constructed Response-Short			
(n=32) Mean	20.78	19.46	19.80
SD	5.52	4.01	5.07

Table 7
Mean Correct Responses on the Remaining Technical Posttest
for Low, Medium, and High A-Trait Students
in Response Mode and Length Conditions

Groups	A-Trait Level Low	Medium	High
Reading Long (n=32)			
Mean	31.33	32.15	31.30
SD	19.27	18.76	12.75
Constructed Response-Long			
(N=32) Mean	33.44	28.31	33.60
SD	13.86	17.79	21.38

This triple interaction was significant at the $p < .05$ level ($F=4.48$, $df=2/116$). As shown in Figure 3, for low A-Trait subjects, those in the reading-short group had better performance on the familiar posttest than either of the other groups; whereas for middle A-Trait subjects, those in the reading long group performed better than either subjects in the constructed response short or the reading short groups, with the poorest performance of MA subjects in the constructed response long group. For high trait subjects in the constructed response groups, their performance was much poorer than any of the three other groups. In addition, the response mode by length interaction was significant ($F=5.13$, $df=1/116$). As is shown in Figure 4, it was indicated that whereas there was little difference in the reading group in the long and short versions, subjects in the shorter version of the constructed response materials performed significantly better than the familiar posttest subjects in the long version of the constructed response materials. The performance of the constructed response-short group was approximately the same as the reading group. Furthermore, students in the constructed response version had fewer correct responses ($\bar{X}=16.83$). This main effect of response modes was significant at the $p < .001$ level ($F=17.73$, $df=1/116$).

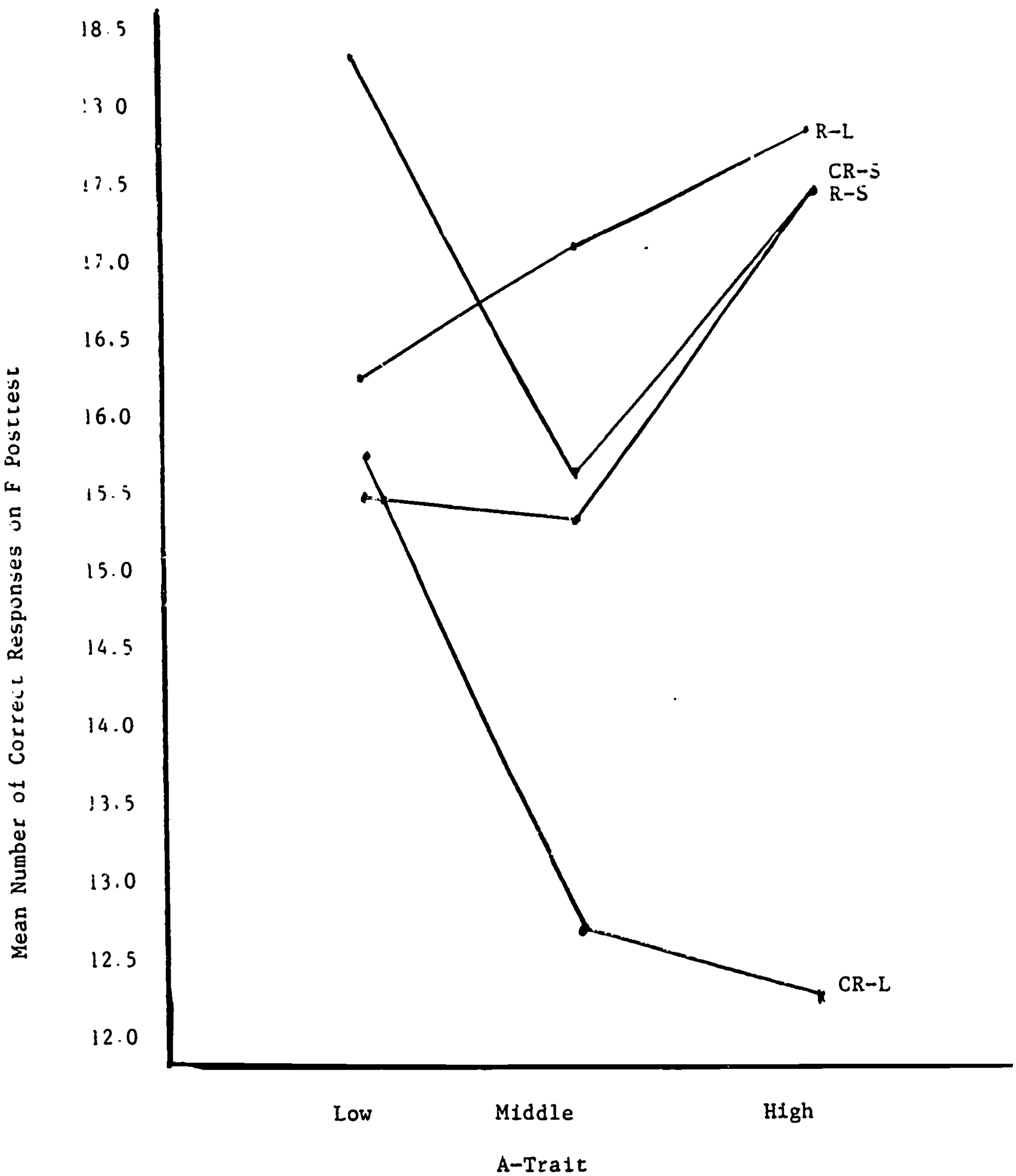


Figure 3. Mean number of correct responses on F posttest for LA, MA, and HA students in the response mode and length conditions.

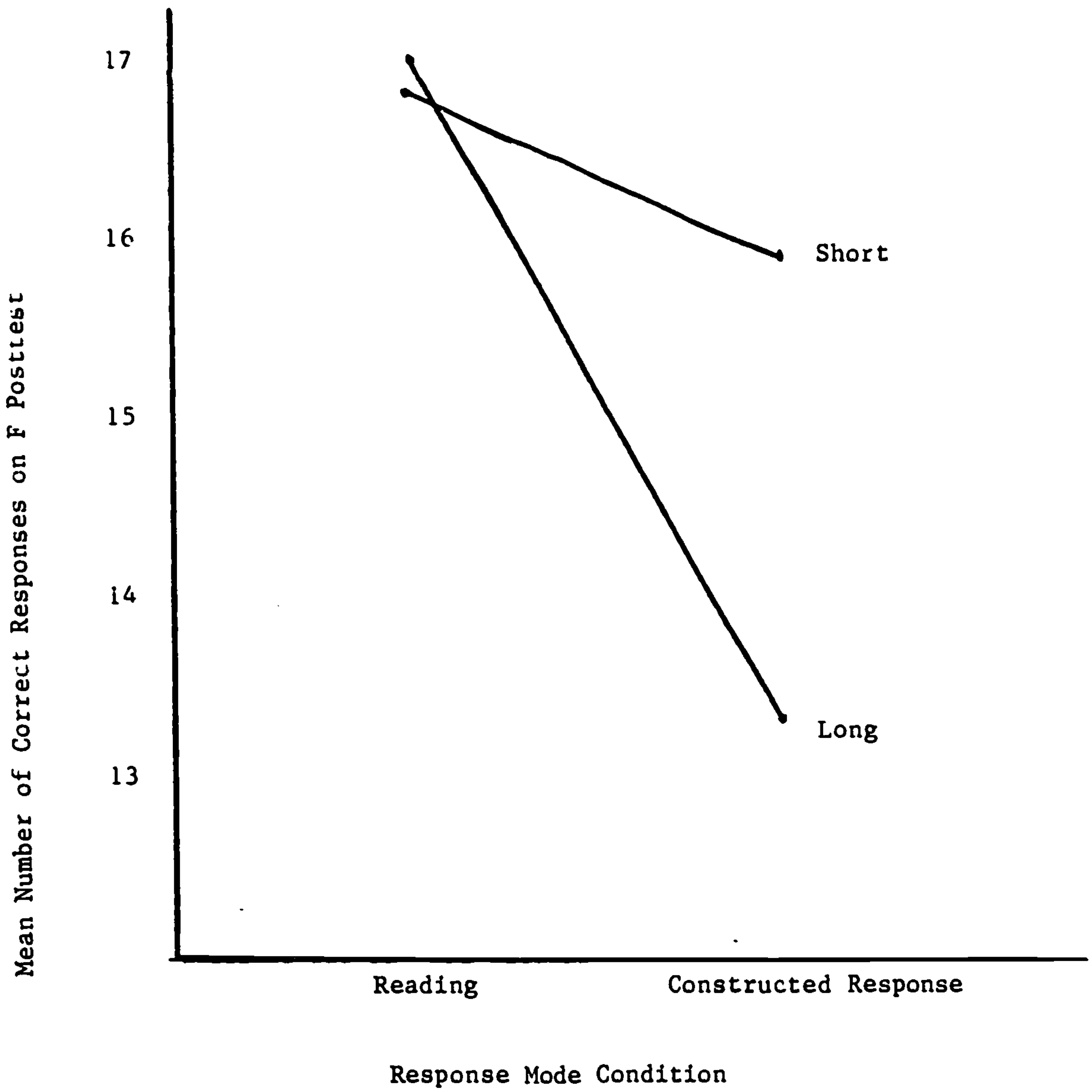


Figure 4. Mean number of correct responses on F posttest for students in the response mode and length conditions.

Results of the analyses on the initial technical posttest indicated that subjects in the constructed response group had more correct responses ($\bar{X}$- 19.55) than subjects in the reading group ($\bar{X}$=16.83). This main effect of response mode was significant at the p $<$.001 level (F=11.55, df=1/116). No other main effects or interactions were significant.

The effect of A-Trait and response modes was investigated on the remaining technical posttest. The reader may note that since subjects in the short versions did not receive the remaining technical learning materials, they therefore did not receive the remaining technical portion of the posttest. The results of the analysis of variance on a technical posttest revealed that no main effects or interactions were significant, indicating that neither level of A-Trait nor response mode effected remaining posttest performance.

Effects of Response Modes and Length on Posttest Performance for Low, Medium, and High A-State Students

Since Leherissey et al. (1971) found that low A-State students made more correct responses than either medium or high A-State students on the posttest, this relationship was examined in the present study. The means and standard deviations for correct responses on the familiar and initial technical portions for the posttest for low, medium, and high A-State students in the response modes and length conditions are presented in Tables 8 and 9, respectively. Table 10 represents the means and standard deviations on the remaining technical posttest for low, medium, and high A-State students in the constructed response-long and reading-long groups.

Table 8
Mean Correct Responses on the Familiar Posttest
for Low, Medium, and High A-State students
in Response Mode and Length Conditions

Groups	A-State Level Low	Medium	High
All groups (N=128)			
Mean	16.99	16.40	13.74
SD	2.78	3.07	3.27
Reading-Long (N=32)			
Mean	16.71	17.82	15.86
SD	2.67	2.71	2.19
Reading-Short (N=32)			
Mean	18.75	16.91	13.89
SD	2.09	2.70	3.92
Constructed Response-Long			
(N=32) Mean	15.50	13.67	11.93
SD	2.83	2.87	1.98
Constructed Response-Short			
(N=32) Mean	16.38	16.67	14.67
SD	2.92	2.87	3.73

Table 9
Mean Correct Responses on the Initial Technical Posttest
for Low, Medium, and High A-State Students
in Response Mode and Length Conditions

Groups	A-State Level Low	Medium	High
All groups (N=128)			
Mean	18.31	19.65	16.39
SD	5.11	3.14	5.73
Reading-Long (N=32)			
Mean	16.07	19.00	16.57
SD	5.50	3.41	4.50
Reading-Short (N=32)			
Mean	17.42	19.00	11.11
SD	4.96	3.52	6.97
Constructed Response-Long			
(N=32) Mean	20.75	18.78	18.53
SD	3.50	2.73	3.29
Constructed Response-Short			
(N=32) Mean	21.13	21.50	17.58
SD	4.32	2.28	5.90

Table 10
Mean Correct Responses on the Initial Technical Posttest for Low, Medium, and High A-State Students in Long, Response Mode Conditions

Groups	A-State Levels Low	Medium	High
All groups (N=64)			
Mean	37.23	28.40	28.68
SD	16.54	15.69	18.00
Reading-Long (N=32)			
Mean	33.93	31.46	27.43
SD	16.46	17.61	17.51
Constructed Response-Long			
(N=32) Mean	43.00	24.67	29.27
SD	16.05	12.99	18.81

Two three-factor analyses of variance were calculated on the familiar and initial technical posttest. Independent variables for these analyses were level of A-State during the posttest (low, medium, high), response mode conditions (R, CR), and length (short, long). In the final analysis for the remaining technical materials, the independent variables were level of A-State during the posttest (low, medium, high), and response modes conditions (R, CR). Students were divided into low, medium, and high A-State groups by ranking the distribution of A-State scores on the retrospective A-State measure given after the posttest and dividing this distribution into thirds. The range of low A-State scores was 5-8; medium A-State scores ranged from 9-12; the range of high A-State scores was 13-20. The reader may note that the students in the short versions did not receive the remaining technical materials and thus did not receive the remaining technical posttest.

The results of the analysis of variance on the familiar posttest scores indicated that there was a significant A-State by response mode and by response mode interaction ($F=3.18$, $df=2/116$, $p<.05$). As is shown in Figure 5, increasing

levels of A-State were debilitating on familiar posttest performance for all groups. Moreover, the constructed response-long group performed consistently poorer than the other treatment groups. Further, while the reading-short condition resulted in the best performance for low A-State students, this condition for high A-State students was debilitating. For the reading-long group, their performance was realtively consistent for all levels of A-State.

Results of the ANOVA on the initial technical posttest indicated a significant A-State by length interaction ($F=3.21$, $df=2/116$, $p < .05$). As is shown in Figure 6, the students in the long versions performed relatively the same, independent of A-State level. In contrast, in the short versions, medium A-State students performed better than either low or high A-State students. Further, the main effect of response modes was significant at the $p < .001$ level ($F=15.65$, $df=1/116$) with the constructed response groups scoring higher ($\bar{X}=19.55$) than the Reading groups ($\bar{X}=16.69$). It was also shown that A-State was a significant factor effecting performance on the initial technical posttest ($F=7.5$, $df=2/116$, p .001), as medium A-State students scored higher ($\bar{X}=19.65$) than either high ($\bar{X}=16.30$) or low ($\bar{X}=18.31$) A-State students.

The results of the analysis on A-State and response mode on the technical-remaining posttest indicated that no main effects or interactions were significant. Neither level of A-State nor response mode affected students remaining technical scores.

Given that the pretest scores were affected by response mode and length, all preceding analyses were recalculated, using the pretest as a covariate on the posttest scores. The results of these analyses of covariance yeilded the same statistical conclusions, therefore, these results are not reported.

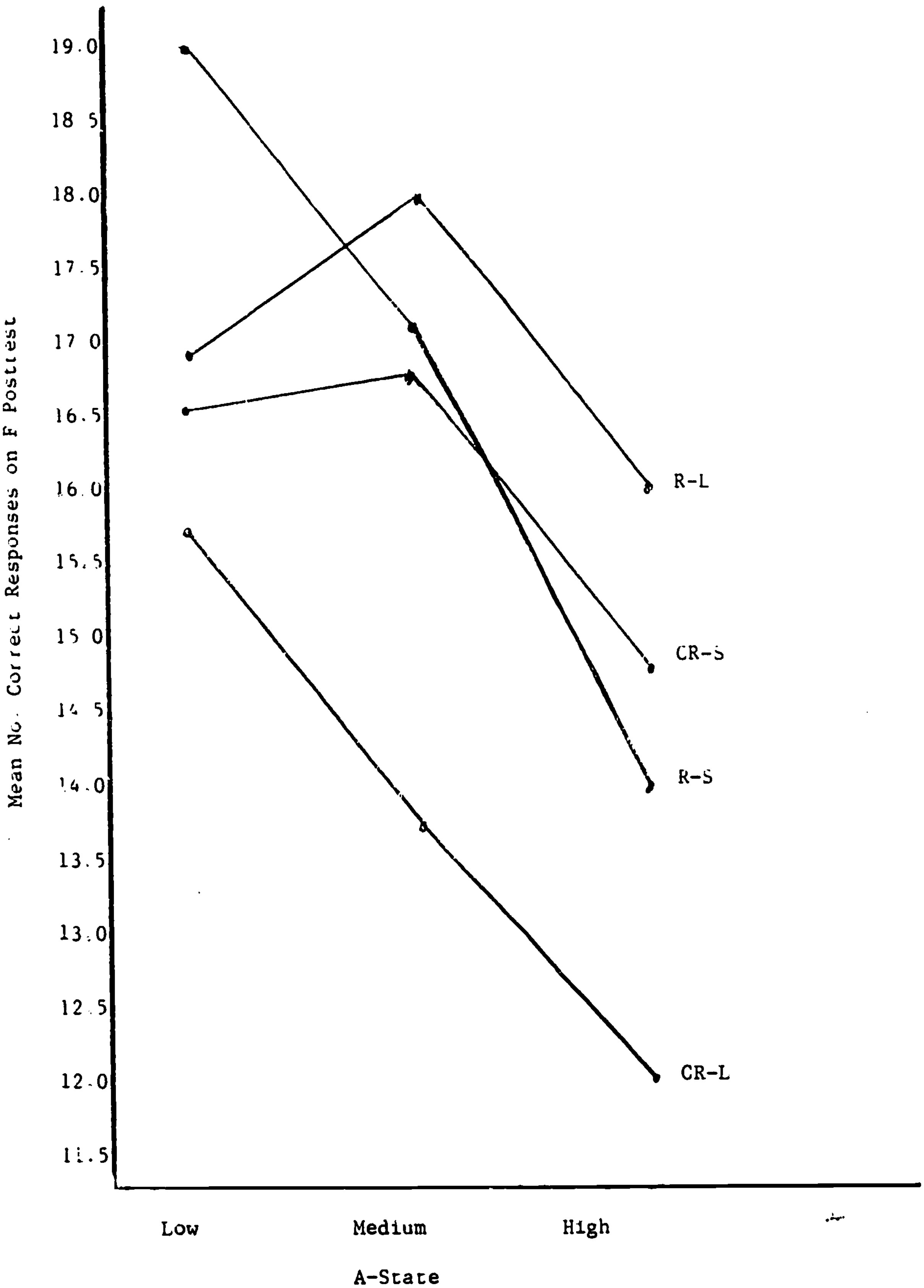


Figure 5. Mean number of correct responses on the F posttest for low, medium, and high A-State students in the response mode and length conditions.

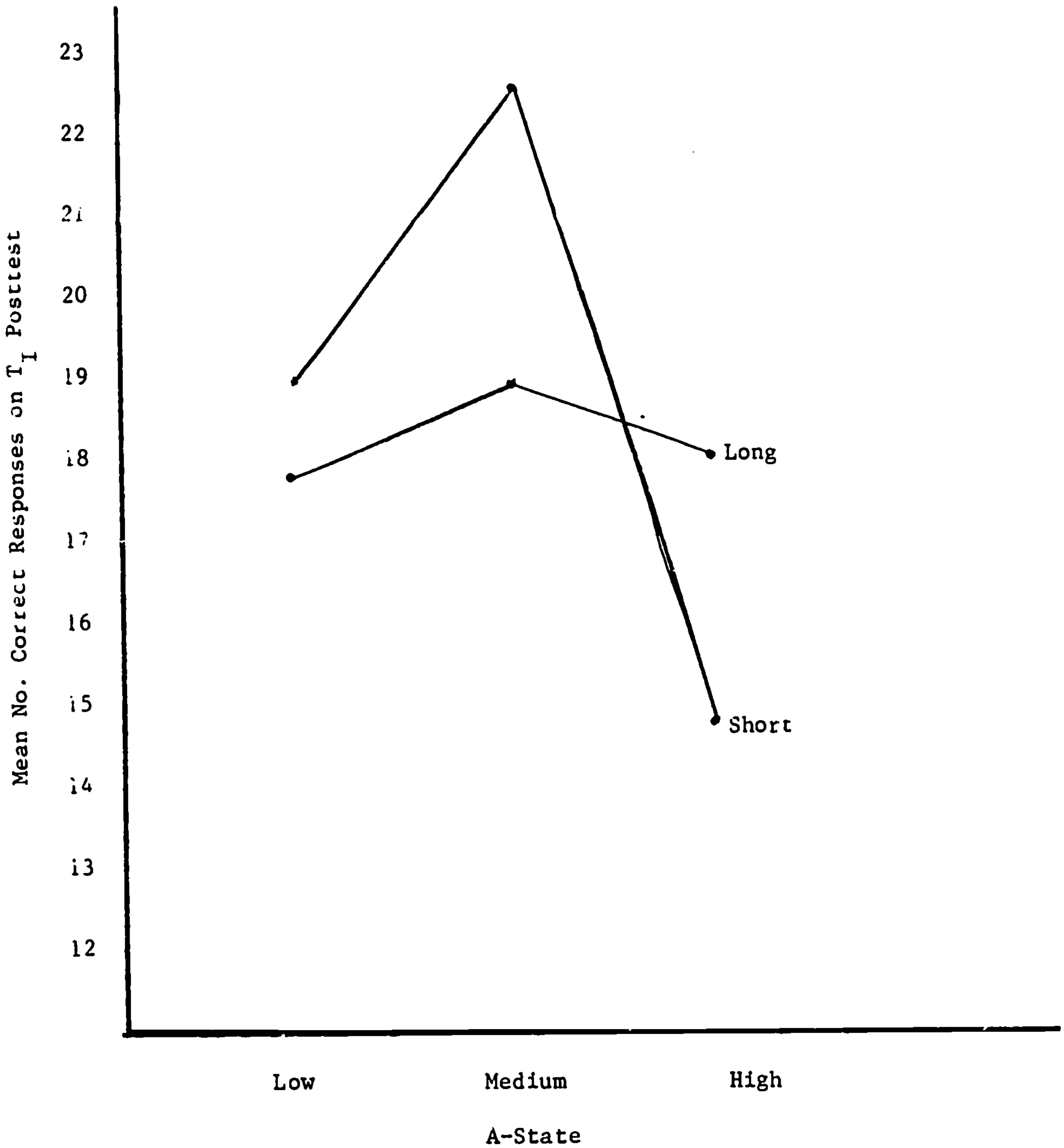


Figure 6. Mean number of correct responses on the T_I posttest for low, medium, and high A-State students in the length conditions.

Learning Time Data

Effects of Response Modes and Length on Learning Time Data for LA, MA, and HA Students

The means and standard deviations for mean learning times of LA, MA, and HA students in the response mode and length conditions are presented in Table 11.

Table 11
Mean Learning Times of Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups		A-Trait Level Low	Medium	High
Reading-Long (N=32)				
	Mean	49.00	45.46	44.30
	SD	22.63	8.22	9.7[illegible]
Reading-Short (N=32)				
	Mean	25.00	26.23	29.20
	SD	2.40	5.88	6.39
Constructed Response-Long				
(N=32)	Mean	120.33	122.85	120.10
	SD	29.42	18.23	22.13
Constructed Response-Short				
(N=32)	Mean	65.89	65.08	68.60
	SD	10.60	17.07	6.31

In order to determine whether students of different A-Trait levels in the response mode and length conditions would differ on total time spent on learning materials, a three-factor analysis of variance was calculated. Independent variables in this analysis were level of A-Trait (LA, MA, HA) response mode conditions (R, CR), and length (short, long). The dependent variable in this analysis was mean number of minutes spent on the learning task.

Results of the analysis of the variance of these data indicated a length by response mode interaction ($F=41.95$, $df=1/116$, $p<.001$), which indicated as is shown in Figure 7 that there was little difference in total time for subjects in

the reading group as a function of length. For subjects in the constructed response group length was a determining factor in total time. In addition, the main effect of response mode was significant ($F=446.10$, $df=1/116$, $p<.001$), indicating that subjects in the reading group spent significantly less time ($\bar{X}=46.09$) than subjects in the constructive response group ($\bar{X}=121.25$). In addition, subjects in the short version spent significantly less time ($\bar{X}=46.61$) than subjects in the long version ($\bar{X}=83.67$). This main effect of length was significant at $p<.001$ ($F=186.24$, $df= 1/116$).

Hostility Data on Experimental Session

Effects of Response Modes and Length on Hostility Scores for LA, MA, and HA Students

The means and standard deviations of hostility scores for LA, MA, and HA students in the response mode and length conditions are presented in Table 12.

In order to investigate the relationship between A-Trait, response modes, and length on total MAACL hostility scores, an analysis of variance was calculated in which level of A-Trait (LA, MA, and HA) response modes (R, CR), and length (short, long) were the independent variables. This analysis revealed that the constructed response groups had higher hostility scores ($\bar{X}=12.78$) than the reading group ($\bar{X}=10.72$). This main effect of response modes was significant at the $p<.001$ level ($F=14.40$, $df=1/116$). No other main effects nor interactions were significant, indicating that neither A-Trait nor program length differentially effects hostility levels.

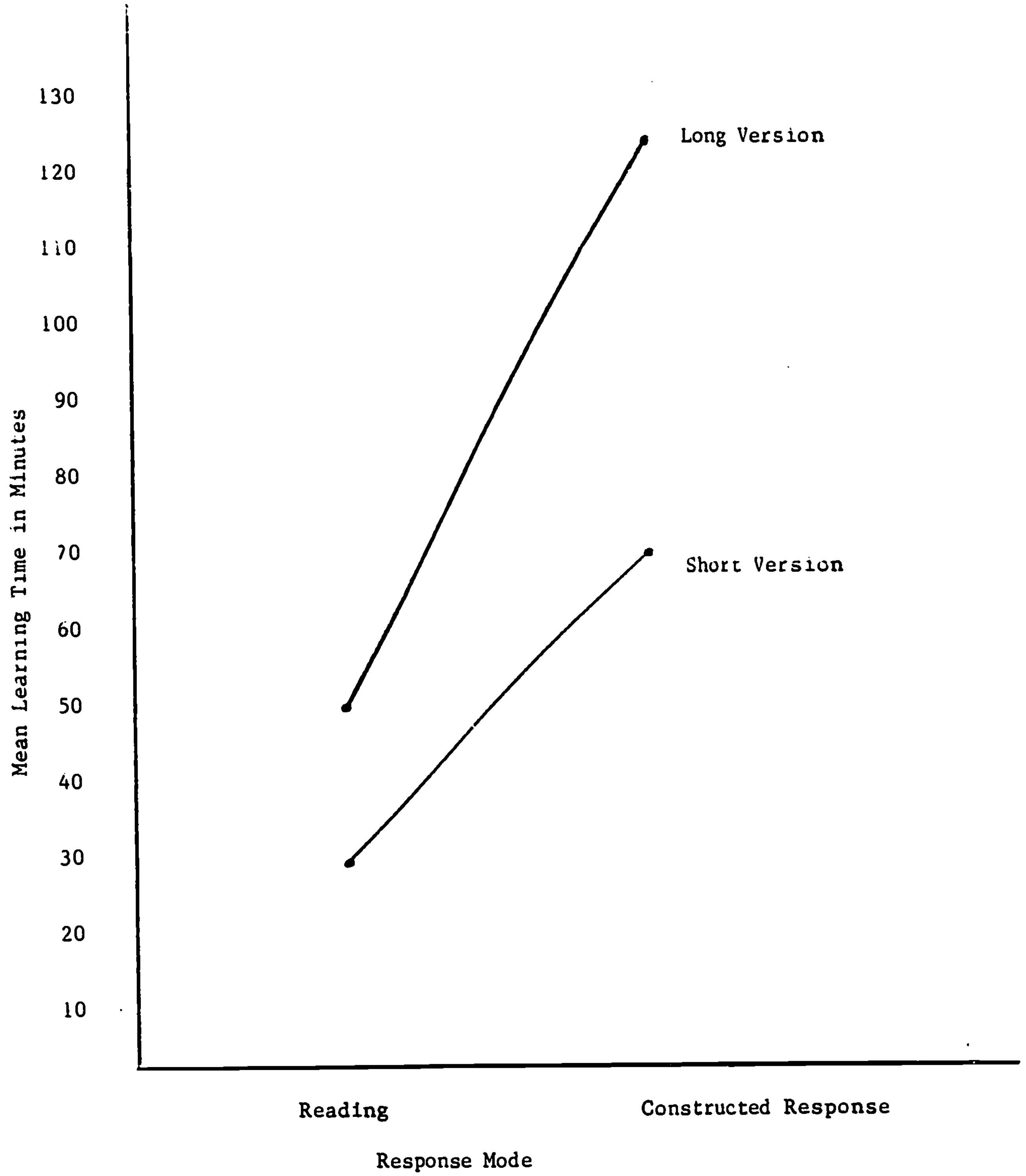


Figure 7. Mean learning times for students in the response mode and length conditions.

Table 12
Hostility Scores for Low, Medium, and High A-Trait Students in Response Mode and Length Conditions

Groups		A-Trait Level Low	Medium	High
Reading-Long (N=32)				
	Mean	10.44	10.92	10.70
	SD	2.35	3.62	3.89
Reading-Short (N=32)				
	Mean	9.56	11 85	10.30
	SD	2.74	4.91	1.06
Constructed Response-Long				
(N=32)	Mean	13.00	13.73	13.10
	SD	2.40	2.62	1.29
Constructed Response-Short				
(N=32)	Mean	12.22	11.69	13.60
	SD	2.39	3.57	4.17

Discussion

The purpose of the present study was to replicate and extend the major findings of Leherissey et al. (1971). Specifically, the present study sought to reduce state anxiety and improve performance by shortening the amount of time spent on the instructional materials. Thus, the findings of the present study will be summarized in the order of (a) the replicable findings; (b) the effects of reducing program length on state anxiety; and (c) the effects of shortening program length on performance. In addition, the effects of hostility, as measured by the Multiple Affect Adjective Check List (Zuckerman et al., 1965) will be discussed.

The findings of the present study which replicated those of Leherissey et al. (1971) include the finding that, in general, high A-Trait students had higher levels of A-State throughout the experimental task than either medium or low A-Trait students, thus supporting Trait-State Anxiety Theory predictions. In addition, the A-State analyses of both studies indicated that A-State scores

decreased for both the reading and constructed response groups from the pre- to familiar measures, remained relatively constant for the reading group following the technical materials, but increased for the constructed response group on the technical A-State measure. Further, students in the constructed response groups were found to have higher levels of A-State during the posttest than students in the reading groups.

Regarding the replicated performance results, neither level of A-Trait nor level of A-State affected student performance on the pretest. Results of posttest performance in both studies indicated that students in the reading groups performed better than students in the constructed response groups on the familiar portion of the posttest. With respect to the total time required to learn the instructional materials as subjects in the reading groups.

With respect to the A-State findings in the present study which did not replicate those of the prior study, it should be noted that the performance of A-State measures used in each study were not directly comparable. Students in the long versions were not directly comparable, in that in the present study they responded to only the remaining technical materials on the final in-task A-State measure, whereas in the prior study, they were instructed to give an anxiety rating on the entire technical task. Thus, the failure to replicate some of the A-State findings may have been due in part to this methodological factor.

With respect to performance results in both studies, several findings failed to replicate. First, the interactions involving A-Trait level and response modes on the familiar posttest were in the opposite directions. That is, in the prior study whereas high A-Trait students in the constructed response group performed better than low A-Trait students, and low A-Trait students in the reading group performed better than the high A-Trait students on the familiar portion of the posttest; the reverse was true in the present study. In

addition, low A-State students in the present study were found to perform significantly better than high A-State students on the familiar posttest, while there was no main effect of A-State in the prior study.

The hypothesis that students in the long constructed response version would have higher levels of A-State than students in the long reading version, whereas there would be no difference in the A-State scores of students in the short reading and constructed response versions, was not supported in the present study. Although the reading and constructed response groups were not found to differ in A-State scored during the familiar materials, the constructed response groups had higher levels of A-State during the initial technical materials, the remaining technical materials, and the posttest than the reading groups. Thus, shortening program length was not found to be effective in reducing state anxiety during the learning task and posttest for students in the constructed response group.

It was further hypothesized that shortening program length would improve the posttest performance of students in the constructed response short group relative to the performance of students in the reading short group. Relevant to this hypothesis was the significant interaction between response modes and program length on the familiar posttest which indicated that whereas ther was little difference in the performance of students in the long and short reading groups, students in the short constructed response version performed significantly better than students in the long constructed response version.

In addition, there was a significant interaction between level of A-State, response modes, and program length on the familiar portion of the posttest, which indicated that level of A-State was not as debilitating to the performance of students in the short constructed response version relative to the performance of students in the long constructed response version. That is, medium and high A-State students in the short constructed response version performed at approximately the same level as students in the reading versions; whereas for

students in the long constructed response version, level of A-State was particularly debilitating to the performance of medium and high A-State students. This interaction thus provides some indirect evidence of the differential effects of A-State for students in the short and long program versions.

An analysis of the performance of students on the initial technical posttest partially supports the hypothesis that shortening instruction time would improve performance in that only for the medium A-State group, did shortening length improve performance. However, for the high A-State group, this procedure was debilitating. Thus, shortening program length was only partially effective in improving the performance of students on the familiar and initial technical posttest.

With respect to the hostility findings, it was found, as predicted, that students in the constructed response groups had higher hostility scores than students in the reading groups. Contrary to predictions, however, shortening program length did not effect the hostility scores of students, i.e., students in the long and short program versions did not differ in mean hostility engendered by the learning task.

In summary, the findings of both studies indicated that the impact of the constructed response variable was paramount, in that students in this response mode condition had higher levels of state anxiety, hostility, and poorer performance on the total technical posttest than students in the reading groups. The major findings of both studies, in general, supported Trait-State Anxiety Theory and replicated the effects of response modes and state anxiety on performance in a CAI task. However, the instructional treatment of shortening time spent on the CAI task was not effective in reducing state anxiety. On the familiar and initial technical posttest, shortening program length did prove effective in improving the performance of the constructed response-short relative to long versions, which may have been due to decreased memory

load for this group.

The failure to replicate Tobias' (1968) findings that there was no difference in the performance of the reading and constructed response groups on the familiar PI materials, whereas the constructed response group performed better than the reading group on the technical PI materials, suggests that the nature of the CAI task may contribute to discrepancies between the PI and CAI findings with these learning materials. One major difference between the PI and CAI task relates to the manner in which students in the constructed response groups "drew" EKG tracings. In the PI mode students drew EKG tracings on both the learning program and posttest via paper and pencil, whereas in the CAI mode students "drew" EKG tracings in the learning program by typing numbers with which segments of the EKG tracing were associated. The posttest, however, was administered off the CAI terminal, via paper and pencil, and the students actually drew the EKG tracings. This difference in procedures may very well have contributed to the failure to find superior performance for the constructed response groups on the remaining technical portion of the post-test which covered the EKG tracings.

The present findings, therefore, would seem to indicate that it is not instructional time per se that is the critical variable for reducing state anxiety and improving performance. The intrinsic differences in the nature of the CAI learning task for the constructed response and reading group, including their differential effective and cognitive effects, imply the need to direct research efforts to the study of more relevant task variables.

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